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ABSTRACT

This construction curriculum guide on masonry for secondary students is one of six developed for inservice teachers at Marianas High School in Saipan. The guide provides the rationale, description, goals, and objectives of the program; the program of studies and performance objectives by levels; samples of lesson plans for effective delivery of instruction; and a listing of references. Concepts covered include orientation to masonry construction, safety, tools and equipment, cement, concrete, concrete block masonry, concrete forms, and concrete reinforcement. Appended materials include transparency copies, tests and answer keys, information sheets, and student activities. (CT)

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ED203098

CURRICULUM GUIDE

Construction: Masonry
Secondary Schools

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FOREWORD

This document, Curriculum Guide for Construction (Masonry) is one of several guides developed during the 1980 Summer Session held for in-service teachers at Marianas High School in Saipan. The in-service workshop was made possible through a federal project titled, Vocational Education Personnel Development in the Pacific Basin under Section 135 of Title II of the Education Amendment Act of 1976 (P.L. 94-482).

Experienced teachers and administrators representing the secondary schools of the Commonwealth of the Northern Mariana Islands and the Trust Territory of the Pacific Islands developed the guide to establish curriculum standards for vocational education in their respective school system. It is hoped that this guide will help teachers and administrators improve instruction as well as establish a base for future curriculum development efforts.

The guide provides the rationale, description, goals and objectives of the program; the program of studies and performance objectives by levels; samples of lesson plans for effective delivery of instructions; and a listing of references and texts.

Constructive comments and recommendations will be appreciated. These should be forwarded to either the Department of Education, Commonwealth of the Northern Mariana Islands or Bureau of Education, Trust Territory of the Pacific Islands.

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This Curriculum Guide for Construction (Masonry) is the result of the cooperative efforts of many people in the Commonwealth of the Northern Mariana Islands, the Trust Territory of the Pacific Islands, and the State of Hawaii. Experienced teachers from the CNMI, TTPI, and University of Hawaii personnel, have contributed toward the development of this guide. However, this guide is for both the Commonwealth of the Northern Mariana Islands and the Trust Territory of the Pacific Islands. The following persons are acknowledged as participants, consultants, evaluators, and support staff for the development of this guide.

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TABLE OF CONTENTS

		PAGE
FOREWORD		i
ACKNOWLEDGEMENTS		ii
INTRODUCTION		1
COURSE OUTLINE		2
Unit I	ORIENTATION	4
Unit II	SAFETY	6
Unit III	TOOLS & EQUIPMENT	8
Unit IV	CEMENT	9
Unit V	CONCRETE	12
Unit VI	CONCRETE BLOCK MASONRY	14
Unit VII	CONCRETE FORMS	16
Unit VIII	CONCRETE REINFORCEMENT	19
APPENDIX A	ORIENTATION	21
APPENDIX B	SAFETY	24
APPENDIX C	TOOLS & EQUIPMENT	26
APPENDIX D	CEMENT	34
APPENDIX E	CONCRETE	38
APPENDIX F	CONCRETE BLOCK MASONRY	42
APPENDIX G	CONCRETE FORMS	46
BIBLIOGRAPHY		65

INTRODUCTION

Fed by the twin forces of population increase and technological advance a building boom in the Pacific Islands is inevitable. Not just any old type of building, either. Today our need is for permanent structures that will stand up to a typhoon. This strength and permanence calls for masonry construction and, in turn, for skilled block and concrete masons. A high school vocational course in masonry construction is essential to the development of these skills.

Building construction is a broad field encompassing many closely linked trades and skills. This course is designed to fill the masonry construction portion of an overall vocational education program in Building Construction. This course will be used in conjunction with other vocational training such as carpentry, plumbing, electrical wiring, etc. It may be used as a one semester or one year unit as emphasis and locale dictate. The objective is to prepare the student with entry level skills in the fields of concrete and block masonry.

BUILDING CONSTRUCTION (MASONRY)

COURSE OUTLINE

I. Orientation

- A. Introduction
- B. Course & Class Orientation
- C. Facilities

II. Safety

- A. Terms & Definitions
- B. Equipment
- C. Rules
- D. Pledge

III. Tools & Equipment

- A. Hand Tools
- B. Equipment & Machinery

IV. Cement

- A. History of Cement
- B. Production of Portland Cement
- C. Type & Uses
- D. Mortar

V. Concrete

- A. Composition
- B. Properties of Hardened Concrete
- C. Mixing
- D. Finishing
- E. Curing

VI. Concrete Block Masonry

- A. Types & Sizes
- B. Cutting Block
- C. Laying Block
- D. Reinforcing Block
- E. Estimating
- F. Manufacturing Block

VII. Concrete Forms

A. Terms & Definitions
B. Purpose
C. Form Design
D. Types & Composition
E. Spreaders & Fasteners
F. Form Construction

VIII. Concrete Reinforcement

A. Terms & Definitions
B. Materials
C. Placement

Unit: I. ORIENTATION

Major Objective: After completion of this unit, the student will be able to explain what the course covers, how it will be taught, attendance and grading policy, and shop facilities. He/she will be able to describe the work requirements and occupational outlook for jobs in the mason's trade. The student will be able to complete a personal information sheet.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
Introduction	Introduce him/her self to the class	Tour Vocational Shop facilities
	List one or two facts concerning the occupational outlook for cement masons.	Appendix A
	Name two employment opportunities for the cement mason.	Appendix A
	Demonstrate the ability to complete a personal information sheet.	Appendix A

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
	List the major sub-skills involved in the cement mason's trade	Appendix A
Course & Class Orientation	Describe course content, rules, schedule, attendance, and grading policy	Lecture
Facilities	Identify location of shop facilities & safety equipment.	Lecture

Unit: II. SAFETY

Major Objective: After completion of this unit, the student will be able to recognize unsafe situations and be able to state the rules for shop and personal safety. The student should be willing to sign the safety pledge.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
Definitions	Define the terms safety, accident and first aid.	Lecture Show available safety films Safety: The state of freedom from danger, risk or injury. Accident: Any sudden, unintentional event which causes injury or property damage. First Aid: Immediate temporary care given to the victim of an injury or sudden illness.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
Safety Equipment	Demonstrate the correct use of each piece of shop safety equipment including, goggles, shields, guards, protective clothing, fire extinguishers & alarms.	Lecture, demonstration, student practice Review all machinery guards & safety devices
Safety Rules	List rules for personal safety List rules for general shop safety	Lecture Appendix B
Safety Pledge	Explain & sign the safety pledge	Lecture Appendix B

Unit: III. TOOLS & EQUIPMENT

Major Objective: After completion of this unit, the student will be able to identify by name and correctly use the common tools and equipment of the mason's trade.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
Hand Tools	Identify by name & state the proper use of each tool in the list of selected mason's tools.	Lecture. See Appendix C for list.
	Demonstrate the correct & safe use of each mason's tool available in the shop.	Demonstration, student practice
Equipment & Machinery	Identify by name & explain the use of basic specialized masonry machinery & equipment.	Lecture - Show pictures - Appendix C
	Demonstrate the ability to safely operate available equipment. This will include starting, running, stopping, cleaning & performing normal operator maintenance.	Demonstrate use of available equipment: Concrete Mixer Vibrator Electric Drill Circular Saw Wheelbarrow Trowel Machine Compactor Electric Hammer & Air Hammer Power Straight Edge

Unit: IV. CEMENT

Major Objective: The student will have an appreciation for and general understanding of the importance of cement in the construction industry. He will know composition, proportioning and the many uses of Portland Cement.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
History of Cement	Distinguish between cement & concrete & be able to discuss the historical development of the cement industry.	Lecture Display - Cement powder & a piece of solid concrete Appendix D Reference: Concrete Technology Delmar, Unit 4
Production of Portland Cement	Name the raw materials used in the manufacture of Portland Cement & briefly explain the production processes.	Lecture Draw a production flow chart Raw Materials: Lime, Silica, Iron Oxide, Alumina, Gypsum.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
		Reference: Concrete Technology, Delmar, Unit 4
		Appendix D
Types & Uses	Identify by name & explain the purpose & use of four types of Portland Cement	Lecture
		Type I-Normal
		Type II-Modified
		Type III-High early strength
		Type IV-Low Heat
		Type V-Sulfate Resistant
		Reference: Modern Masonry Kicklightes, Chapt. 7
	List two advantages of air entrained cement	Advantages:
		- Improved freeze-thaw resistance
		Improved workability
		Reference: Concrete Technology, Delmar, Unit 7

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
Mortar	List the proportions of five types of mortar & explain where each should be used.	Lecture Reference: Modern Masonry Kicklighter, Chapt. 4
	Measure ingredients & properly mix by hand a batch of mortar	Field demonstration Reference: The Bricklayer, Taylor & Randolph, Unit 2-2

Unit: V. CONCRETE

Major Objective: After completion of this unit, the student will be able to discuss what factors make good concrete, explaining factors such as aggregate grading, water cement ratio, mixing and curing. He/she will be able to properly proportion and mix a batch of cement for a specified job.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
Composition	List four factors to be considered before designing a mix.	Lecture
		Draw charts
	Name the three factors that effect the economy of a mix.	Display various aggregate
	Name four factors to be considered before determinating a satisfactory mix proportion.	Reference: Modern Masonry, Kicklighter, Chapt. 7
		Appendix E
Properties of Harden Concrete	List four principle qualities of hardened concrete	Lecture
		Appendix E

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
Mixing	Select the correct concrete mixture for three construction applications such as footing, slab wall, driveway.	Lecture Show recommended mixture chart. Reference: Modern Masonry, Kicklighter, Chapt. 7
	Properly mix, by hand or machine, a small batch of 3500 psi concrete with a desired slump of 2" to 4" & "prove" mix by making slump test.	Lecture Provide slump test information sheets Appendix E Field Demonstration
Finishing	List in order the four principle steps in finishing concrete & state when each step should be perfomed.	Lecture: Screeding, edging & jointing, floating, troweling Reference: Modern Masonry, Kicklighter, Chapt. 7
	Demonstrate the correct use of a darby or bull float, a small radius edger, & a cement mason's trowel.	Field demonstration
Curing	List four methods of curing concrete & explain the advantages & disadvantages of each. Name the four factors effecting the quality of hardened concrete	Lecture & demonstration Reference: Concrete Technology, Delmar Reference: Concrete Techonology De'mar, Unit 2

Unit: VI. CONCRETE BLOCK MASONRY

Major Objective: After completion of this unit, the student will have an understanding of the manufacture design factors and construction techniques of concrete blocks (CMU - Concrete Masonry Units).

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
Types, size & use of blocks	Identify by name & state the function of commonly used masonry blocks	Lecture Display Blocks Show Pictures Appendix F
	Properly state the nominal & actual size of commonly used blocks	Reference: Modern Masonry, Kicklighter, Chapt. 2
Cutting Block	Make smooth & straight cuts on block using the hammer, brick set & power saw.	Shop demonstration & Student practice Reference: The Bricklayer, Taylor & Randolph, Unit 2-8

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
Laying Block	Lay a simple wall with a corner which is straight, level & plumb.	Field demonstration & student practice with string line, mortar bedding & trowel techniques. References: The Bricklayer, Taylor & Randolph, Chapt. 2
Reinforcing Block	Identify by name & state the function of four types of reinforcing material used in block masonry. Select the correct type of reinforcement for three given locations within a block masonry building.	Lecture Field Trips Reinforcing Material: Rod/Bar Wire Metal Ties Metal Lath References: The Bricklayer, Taylor & Randolph, Unit 7.1
Estimating	Calculate total numbers of blocks required with 10% and/or 15% wastes added. Calculate total number of pieces of Dur-O-Wall needed.	Handout sheet on concrete calculation Appendix F Remember: Dur-O-Wall is at every 3rd layer of block = Over all length / Standard length of one piece of Dur-O-Wall
Manufacting Block	Identify the right mixtures used for concrete block. Operate block machine properly	Common Mixture: 1.3 Assign student to help in the block factor (for at least one hour).

Unit: VII. CONCRETE FORMS

Major Objective: After completion of this unit, the student will have a general understanding of the purpose, design, and material requirements of a good concrete form. He will be able to build a simple form.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
Terms & Definitions	Match terms associated with forms to the correct definition	Lecture Provide students with information sheets
	Identify terms & concepts of using forms	Give quiz Appendix G Reference: Modern Masonry, Kicklighter, Chapt. 10
Purpose of the form	State the purpose of a form	Purpose: To hold the wet concrete in the desired shape until it has set.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
Form design	List seven external factors that effect form design	Lecture Provide student with information sheet Show pictures Give quiz Appendix G
Types & Composition of Forms	Identify the parts of a form Name three types of forms	Lecture Show pictures Provide information sheet Give quiz Appendix G Reference: Modern Masonry, Kicklighter, Chapt. 10
Spreaders & Fasteners	State the purpose of the tie assembly	Lecture Provide information sheet Give quiz Appendix G Reference: Modern Masonry, Kicklighter, Chapt. 10

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
Form Construction	Identify by name the various materials used to build a form Compare & contrast the various sheathing materials State the requirements of a good form Build a simple wall form that is strong, level, & straight.	Lecture Provide information sheets Give quiz Reference: Modern Masonry, Kicklighter, Chapt. 10 Field demonstration & Student practice

Unit: VIII. CONCRETE REINFORCEMENT

Major Objective: Upon completion of this unit, the student will have an understanding of the design factors and material limitations of the various reinforcing materials used in reinforced concrete construction.

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
Terms & definitions	Define the term reinforcement	Lecture
	Distinguish between compression strength & tensile strength.	
	State the reason for using reinforcement	Reference: Concrete Technology Delmar, Unit 18
Materials	Identify by name & explain the principal use of two types of reinforcing materials	Lecture
		Display commonly used re-bar & wire mesh
		Display bar by inch size & number & explain the correlation.
		Reference: Concrete Technology Delmar, Unit 18

SUB-UNITS	PERFORMANCE OBJECTIVES (THE STUDENT WILL BE ABLE TO)	SUGGESTED LEARNING ACTIVITIES
Placement	State a general rule for the placement of reinforcement List minimum concrete protection for reinforcement in, footings, exposed surfaces, slabs & columns. State the rule & give an example of overlap distance when splicing deformed steel bars.	Lecture - Reinforce tensile stress areas Diagram stresses in a horizontal beam & show placement of bar Diagram splice & show minimum 24 dia. Overlap Reference: Concrete Technology, Delmar, Unit 18.

ORIENTATION
UNIT I

INFORMATION SHEET

I. Occupational outlook

A. Job opportunities result each year from the need to replace experienced cement masons who retire or die

B. The number of new construction jobs being done each year requires more cement masons

II. Employment opportunities

A. Independent and union affiliated residential building contractors

B. Independent and union affiliated commercial contractors

C. Repair work on older buildings

D. Precast plants

E. Ready-mix concrete plants

III. Student requirements for the cement mason's program

A. Operate all power tools correctly

B. Be safety conscious and follow safety regulations

C. Take instructions readily and follow directions

D. Be a good citizen

E. Control temper at all times

F. Display enthusiasm about work

G. Exhibit pride in the cement mason's trade

H. Practice conservation of materials and man-hours

I. Be punctual

IV. Major subskills involved in the cement mason's trade

A. Blueprint reading

B. Measuring

INFORMATION SHEET (Cont'd)

C. Use of hand tools

D. Use of power tools

E. Making material estimates

F. Placing, compacting, and rodding concrete

G. Concrete finishing

H. Rubbing and patching

I. Knowledge of material characteristics

ORIENTATION
UNIT I

ASSIGMENT SHEET #1-PERSONAL INFORMATION

NAME_____CLASS_____

HOME ADDRESS_____

HOME PHONE_____

PARENTS' NAMES (or guardians)_____

PARENTS' OCCUPATIONS_____

PARENTS' BUSINESS ADDRESS_____PHONE_____

WHERE CAN YOUR PARENTS BE REACHED IN CASE OF AN EMERGENCY?_____

_____

LIST SHOP COURSES YOU HAVE HAD_____

_____

SKILL EXPERIENCE_____

_____

_____

INFORMATION SHEET

Five Rules of Personal Safety on the Job:

1. Conduct yourself in a manner conducive to safety practices.
2. Use soap and water frequently as a method of preventing skin disease.
3. Remove rings and other jewelry when working.
4. Always wear safety glasses, use suitable helmets and goggles for cutting, chipping, and grinding.

Eight Rules for General Shop Safety:

1. Keep all hand tools sharp, clean, and in safe working order.
2. Report any defective tools, machines, or other equipment to the supervisor.
3. Retain all guards and safety devices except with the specific authorization of the supervisor.
4. Operate a hazardous machines only after receiving instruction on how to operate the machine safety.
5. Report all accidents to the supervisor regardless of nature (or security).
6. Make sure all guards and barriers are in place and adjusted properly before starting a machine tool.
7. Keep the work area floor clean of scraps and litter.
8. Clean up any spilled liquids immediately.

SAFETY
UNIT II

ASSIGNMENT SHEET #1 SAFETY PLEDGE FORM

_____,who is enrolled in Vocational

_____, will, as a part of his shop

experience, operate machines, providing that his parent or guardian

gives written permission.

It is understood that each student will be given proper instruction, both in the use of the equipment and in correct safety procedures concerning it, before being allowed to operate it himself. The student must assume responsibility for following safe practices, and we, therefore, ask that he subscribe to the following safety pledge.

1. I promise to follow all safety rules for the shop.
2. I promise never to use a machine without first having permission from the instructor.
3. I will not ask permission to use a particular machine unless I have been instructed in its use and have made 100% on the safety test for that machine.

Date:_____Student's Signature:_____

I hereby give my consent to allow my son to operate all machines and equipment necessary in carrying out the requirements of the course in which he is enrolled.

Date:_____Parent's Signature:_____

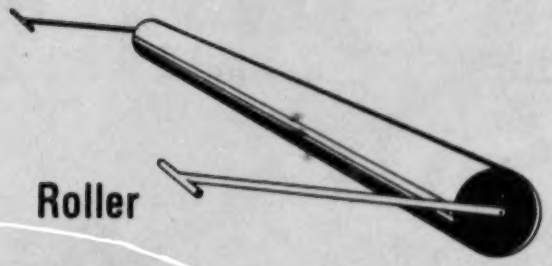
Parents are cordially invited to visit the shop to inspect the machines and to see them in operation.

APPENDIX C
TOOLS AND EQUIPMENT

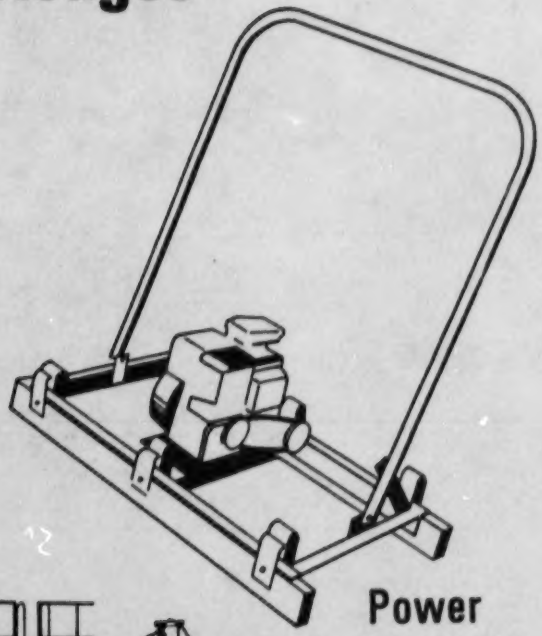
HAND TOOLS:

1. Brick Hammer
2. Pointed Trowel
3. Spirit Level
4. Tape Rule
5. Joint Tools
6. Finishing Trowel
7. Steel Square
8. Brick Set
9. Chalk Line
10. Wood & Metal Float
11. Bull Float
12. Edger
13. Claw Hammer
14. Layout String
15. Rubber Float
16. Sledge Hammer
17. Bolt Cutter
18. Hack Saw
19. Crow Bar
20. Shovel (Mixing)
21. Pliers
22. Cold Chisel

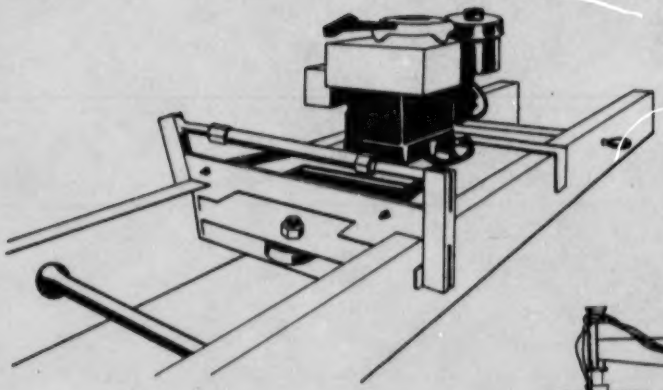
Types of Straightedges



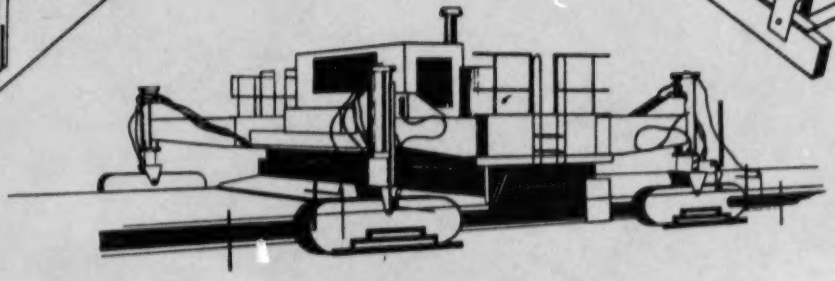
Roller



Power

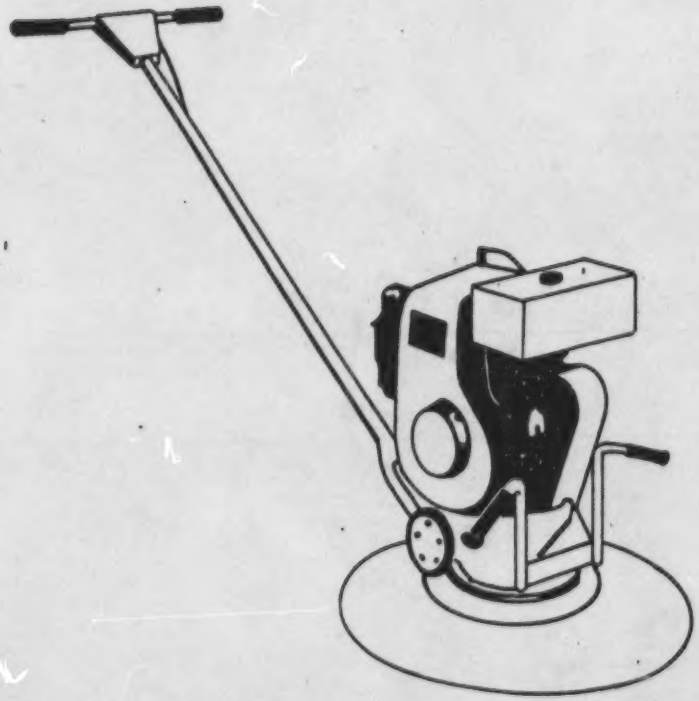


Vibrating

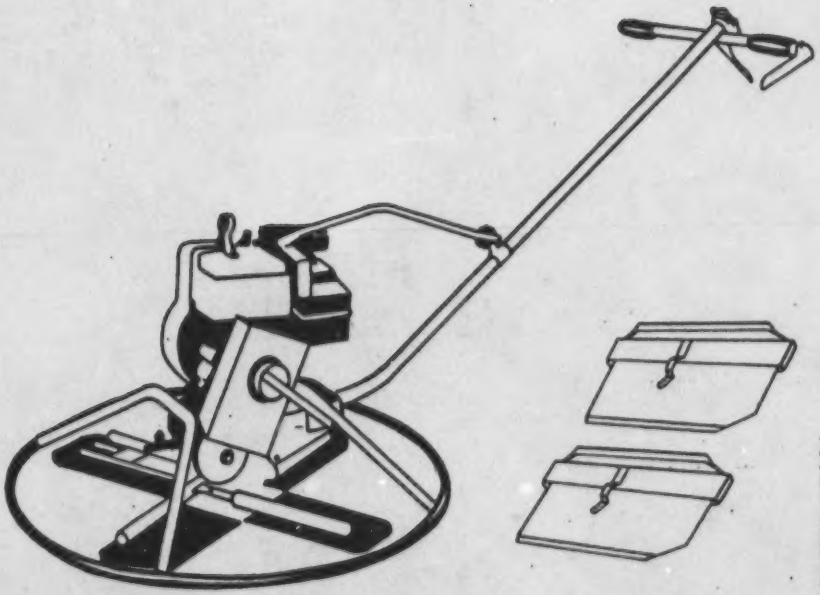


Slip Form Paper

Types of Power Floats

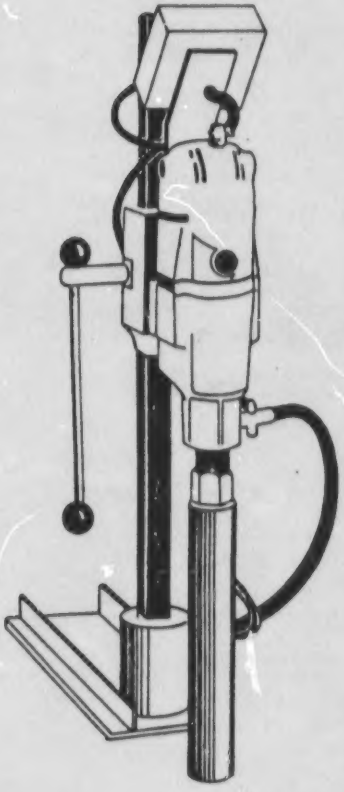


Kelly Float

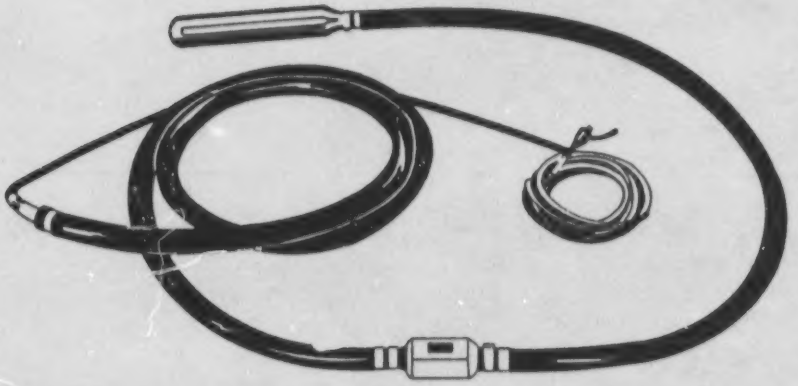


Trowel Machine with Float Blades

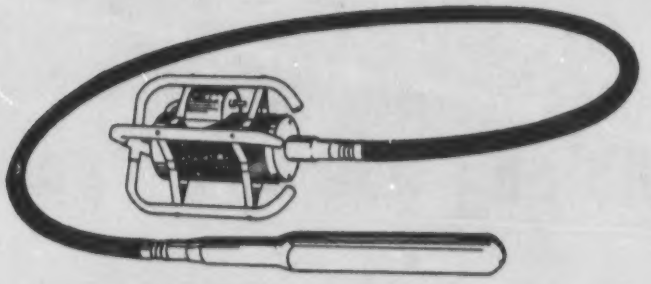
Related Tools and Equipment
(Continued)



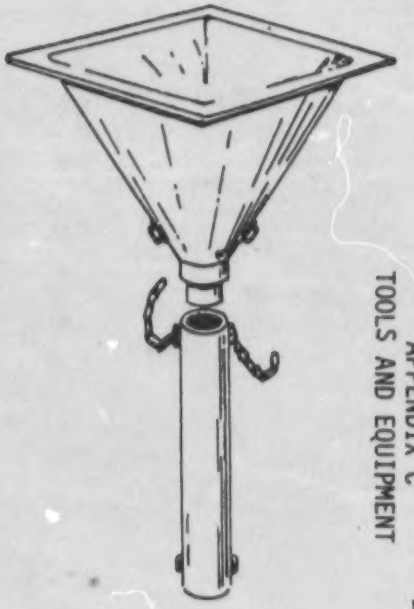
Core Drill



Heavy Duty Electric Vibrator



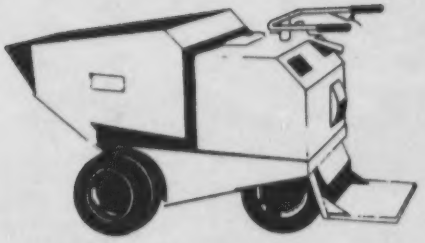
Lightweight Electric Vibrator



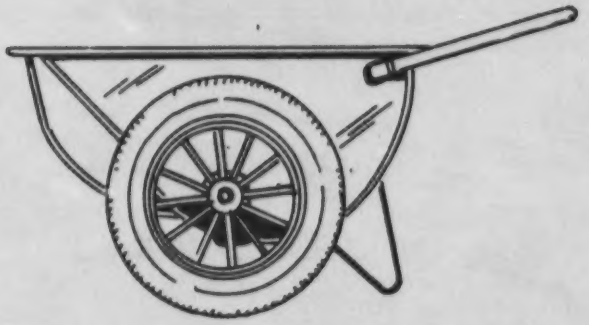
Tremie

Related Tools and Equipment

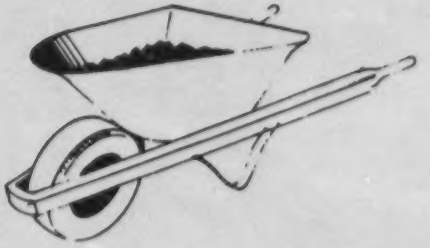
(Continued)



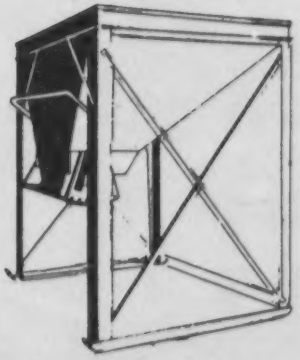
Power Buggy



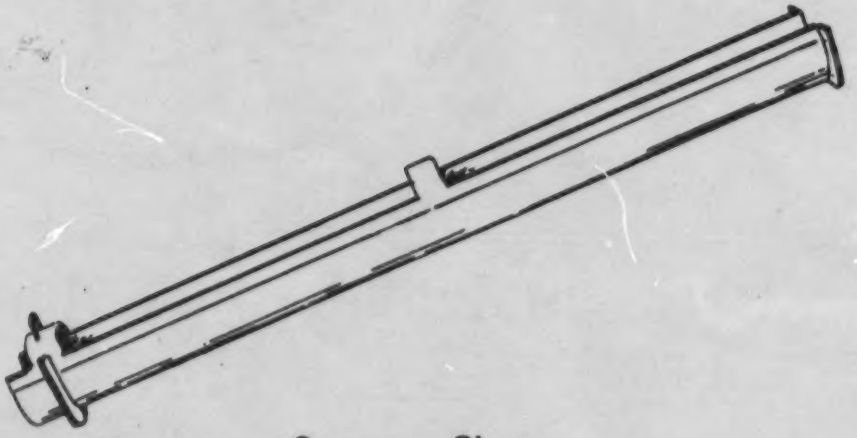
Hand Buggy



Wheelbarrow



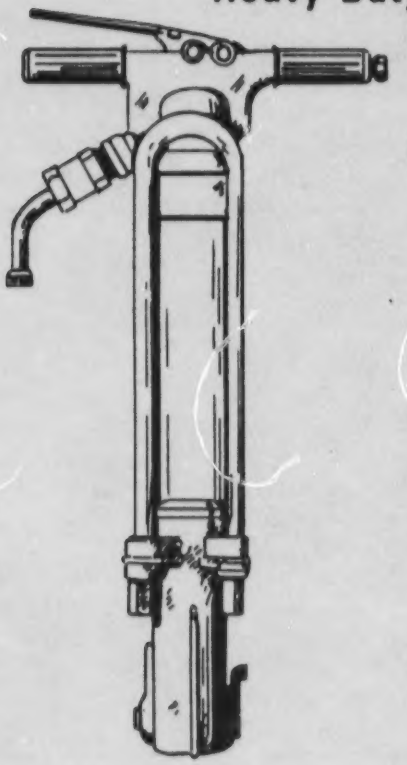
Concrete Hopper



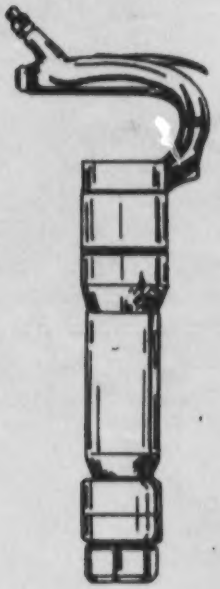
Concrete Chute

Types of Power Hammers

Heavy Duty Hammer

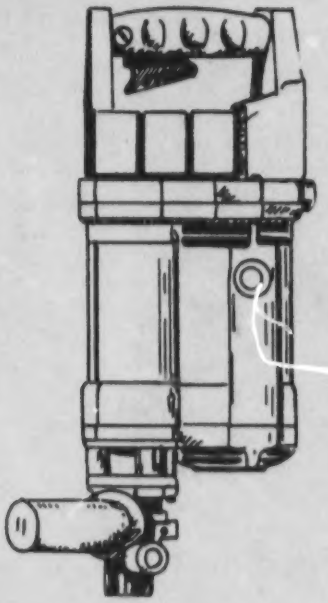


Chipping Hammer



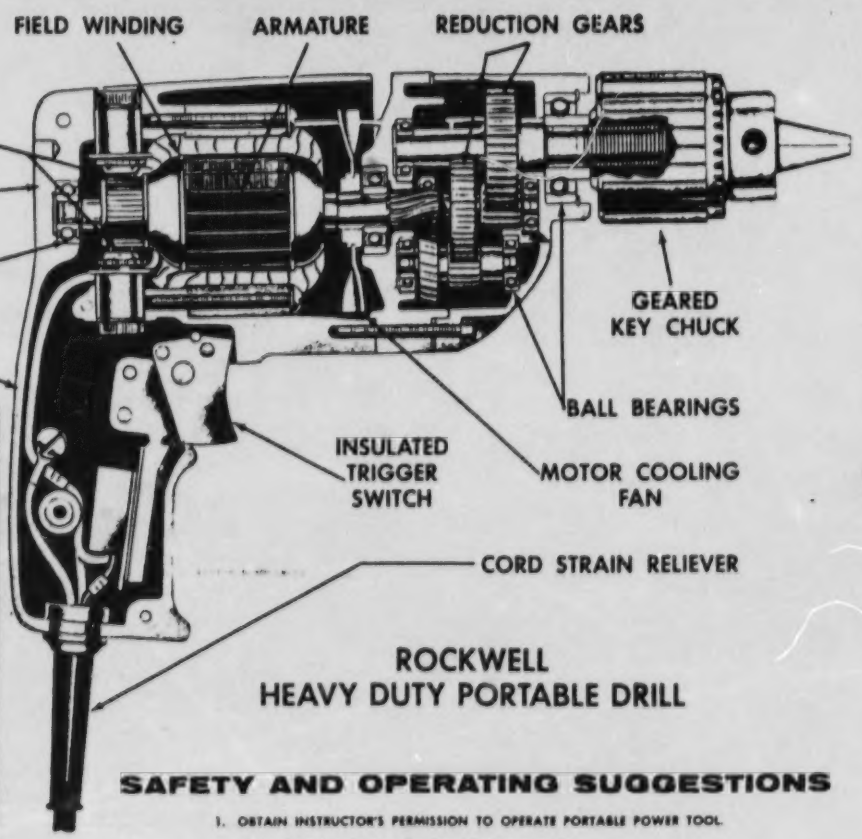
Scaler

Electric Hammer



NOMENCLATURE CHART WITH SAFETY AND OPERATING SUGGESTIONS

Drills



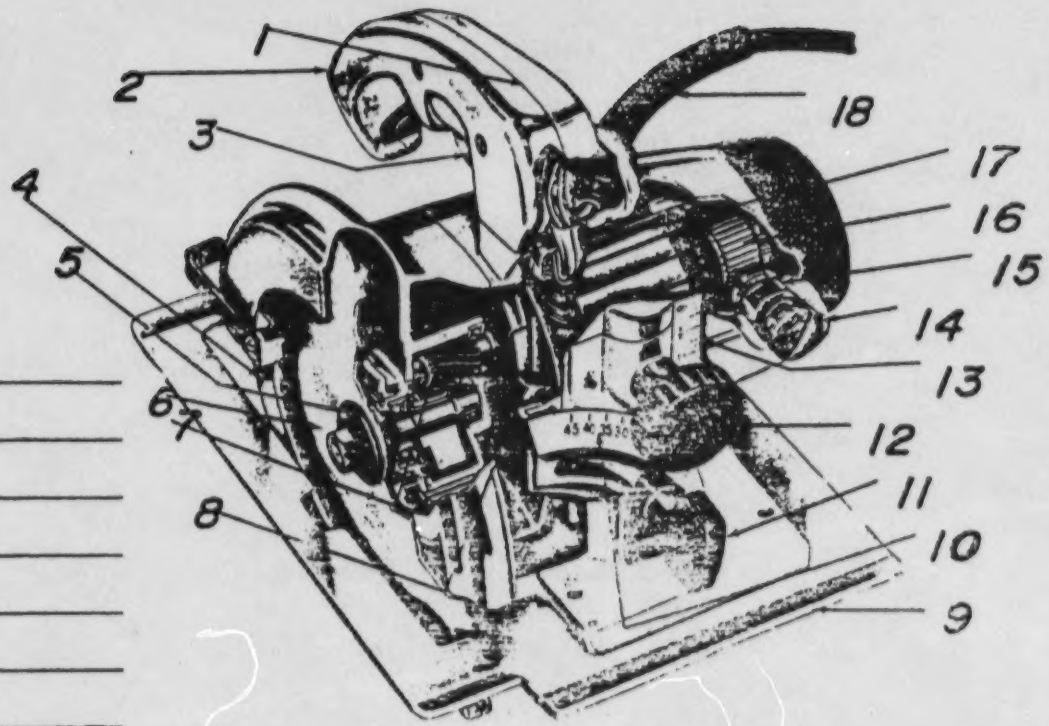
ROCKWELL
HEAVY DUTY PORTABLE DRILL

SAFETY AND OPERATING SUGGESTIONS

1. OBTAIN INSTRUCTOR'S PERMISSION TO OPERATE PORTABLE POWER TOOL.
2. REMOVE TIE, RINGS, WATCH AND ROLL UP SLEEVES.
3. DISCONNECT DRILL FROM POWER SOURCE BEFORE REMOVING OR INSTALLING DRILL BIT.
4. WEAR GOGGLES OR A FACE SHIELD.
5. BEFORE CONNECTING TO POWER SOURCE, MAKE SURE SWITCH IS IN OFF POSITION.
6. BEFORE STARTING DRILL, MAKE CERTAIN DRILL BIT IS SECURELY GRIPPED IN THE CHUCK.
7. CHECK TO SEE THAT KEY HAS BEEN REMOVED FROM CHUCK BEFORE STARTING DRILL.
8. LOCATE EXACT POINT OF DESIRED PENETRATION AND MARK WITH CENTER PUNCH OR AWL.
9. DRILL WITH EVEN, STEADY PRESSURE AND LET THE DRILL DO THE WORK.
10. WHEN WORK IS COMPLETED, DISCONNECT DRILL FROM POWER SOURCE AND REMOVE DRILL BIT.

Rockwell MANUFACTURING COMPANY

60



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61

HISTORY OF CEMENT
UNIT IV

INFORMATION SHEET

I. Terms and definitions

A. Portland cement--Finely ground material consisting primarily of the raw materials lime, silica, alumina, iron ore, and gypsum

B. Hydraulic cement--Cement capable of setting and hardening underwater due to interaction of water and the constituents of cement.

C. Natural cement rock--Natural rock that contains many of the essential chemicals in almost the desired proportions.

D. Portland Cement Association (P.C.A.)--Organization to improve and extend the uses of portland cement and concrete.

E. Sieve-Metallic netting used to separate material according to size.

F. Lime--Calcium oxide taken from limestone, shells, and other forms of calcium carbonate

G. Silica-Silicon dioxide used in making cement

H. Alumina-Material containing aluminum oxide, blended into cement

I. Iron ore--Metallic mineral; one of the basic raw materials used in making cement.

J. Gypsum-Mined mineral used in cement to control set and added to cement in the final process

II. Historical events in the production of cement

A. Word "cement" is more than 2,000 years old

B. Hydraulic cement was produced in Holland in 1200 A.D.

C. In 1756 John Smeaton constructed the Eddystone lighthouse in England (probably first concrete structure built with portland cement)

D. Diversion dam built in San Diego, California, about 1769 (probably first concrete structure built in America)

E. Portland cement was patented in 1824 by Joseph Aspdin (Transparency 1)

F. Portland cement was so named because it resembled a stone on the Isle of Portland, England.

G. First shipment of Portland cement to United States from Europe was in 1868.

H. Natural cement rock was found in large quantities in districts of Rosendale, New York; Lehigh Valley, Pennsylvania; and Louisville, Kentucky.

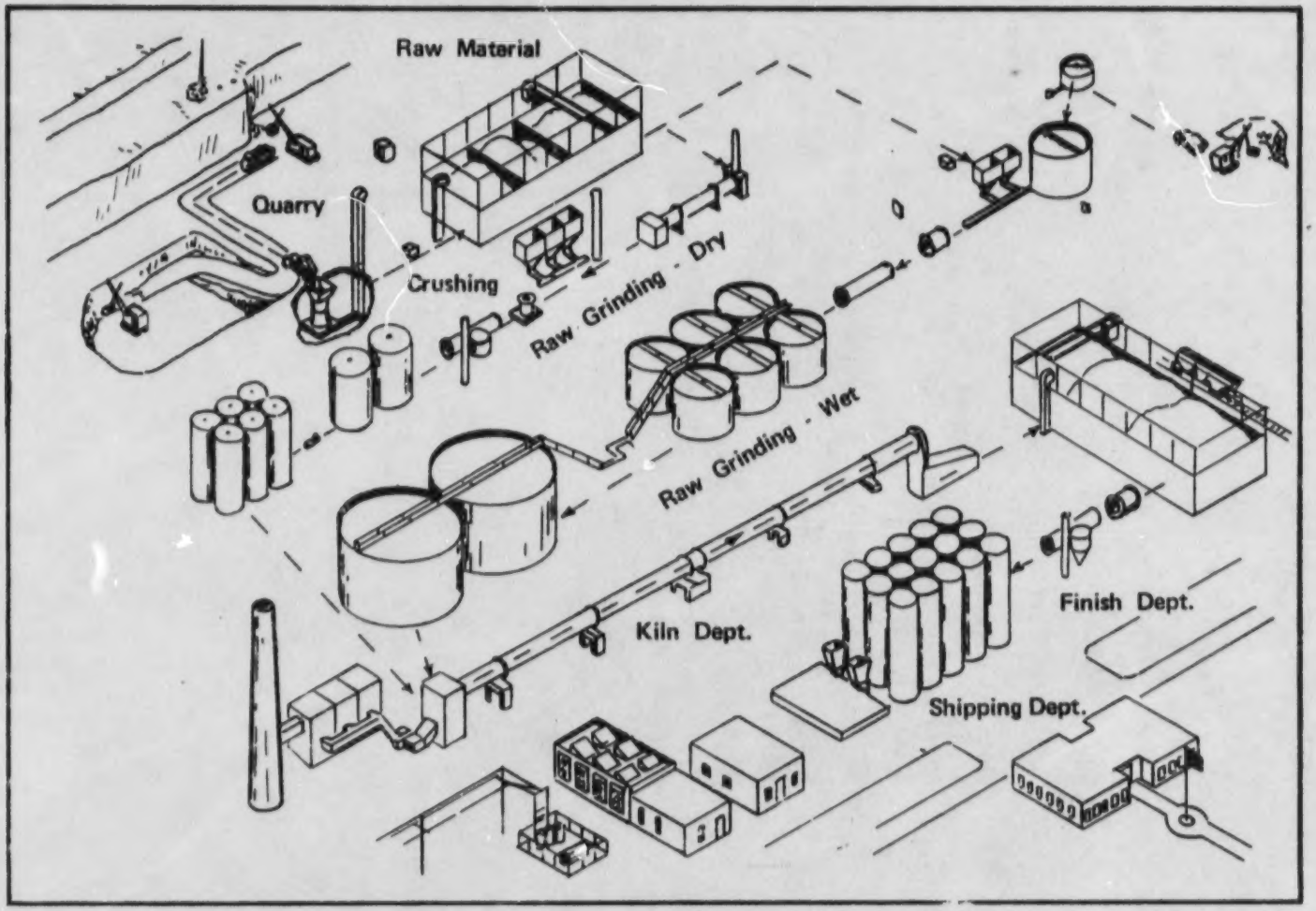
I. In Coplay, Pennsylvania, the site of the first cement plant in the U.S., David O. Saylor started experimenting and the results were so great that he came up with a portland cement that he patented in 1871. This date is regarded as beginning of portland cement in America. In 1876 Saylor's cement won an award at the Centennial Exposition in Pennsylvania (Transparencies 2 & 3).

J. One of the most eminent personalities in America was Robert W. Lesley, a cement manufacturer who became the first president of P.C.A. (formed in 1916)--also wrote the book "History of the Portland Cement Industry in the United States."

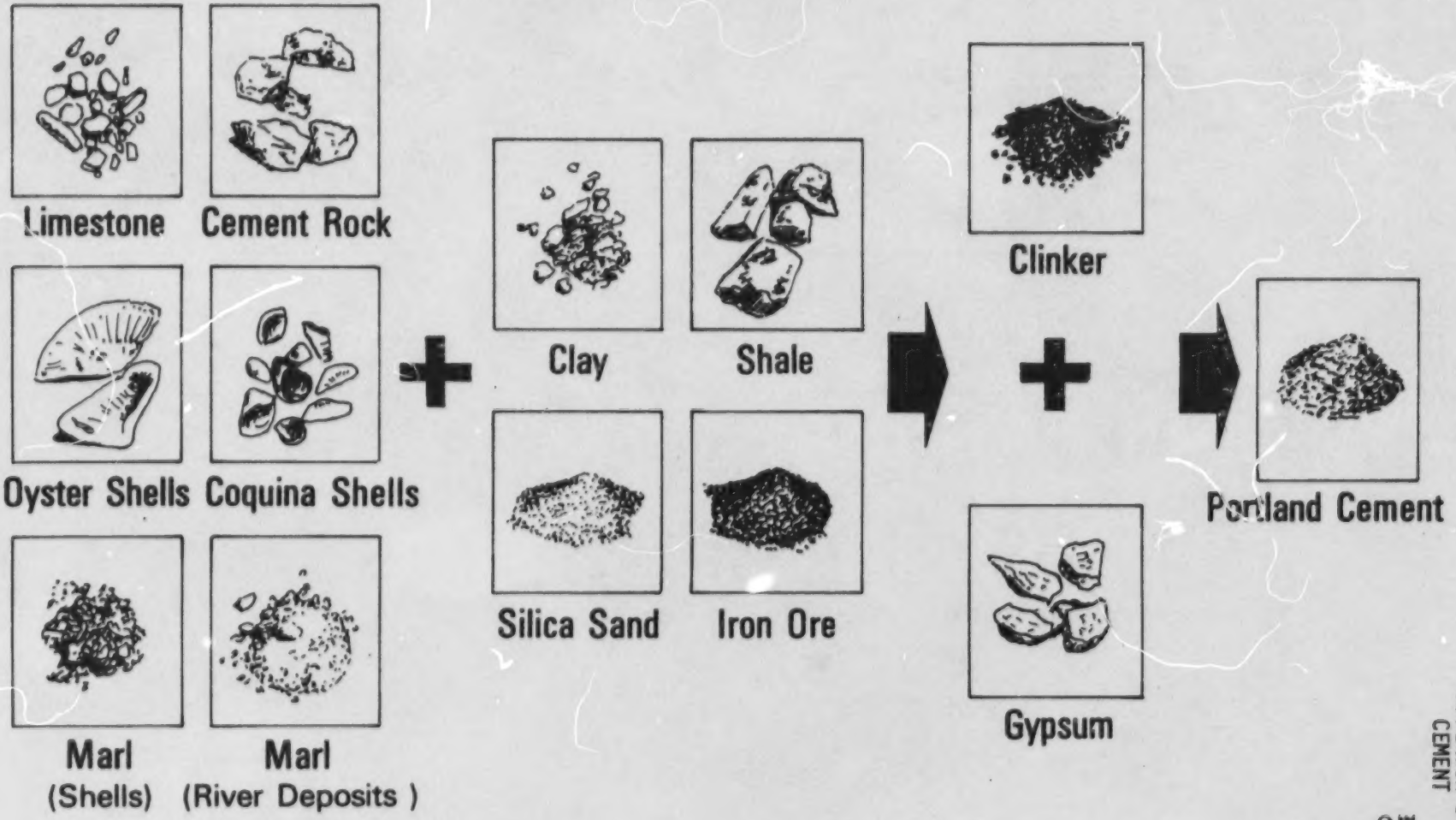
K. One of the oldest concrete structures in United States is the Allen House in Honesdale, Pennsylvania, built in 1857 and still standing (Transparency 4).

L. In 1974, there are 50 cement companies that operate 170 plants with a total yearly capacity of 80-85 million tons of portland cement.

Modern Cement Plant



Basic Raw Materials For Making Portland Cement



INFORMATION SHEET

Factors of Mix Design

A. Size
B. Shape
C. Required Strength
D. Exposure Condition

Economy of Mix Design

A. Stiffest Practical Mixture
B. Largest Aggregate Practical
C. Optimum Ratio of Fine to Coarse Aggregate

Determining Satisfactory Mix Proportion

A. Water/Cement Ratio
B. Maximum Size of Aggregate
C. Air Content
D. Range of Slump

Qualities of Hardened Concrete

A. Durability
B. Wear Resistance
C. Strength
D. Water Tightness

Factors Effecting Quality of Hardened Concrete

A. Water/Cement Ratio
B. Aggregate Size
C. Entrained Air
D. Curing

JOB SHEET: MAKE A SLUMP TEST

I. Tools and Materials

A. Wheelbarrow

B. Slump cone mold

C Bullet-nosed steel rod (smooth), 5/8" by 24"

D. Scoop or trowel

E. Rule

F. Concrete

G. Water in container

II. Procedure

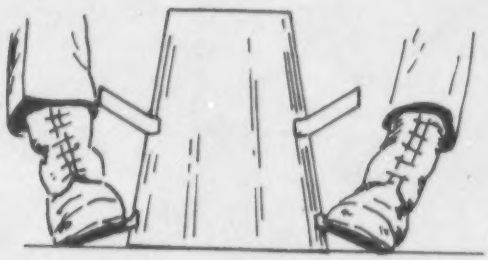
A. Collect concrete in wheelbarrow

B. Dampen slump cone mold with water

C. Place slump cone mold on firm, level, clean, non-absorbent surface

D. Stand on the foot pieces of cone mold to hold it firmly in place (Figure 1).

FIGURE 1



E. Fill 1/3 of cone mold with concrete (Figure 2).

FIGURE 2

F. Rod with up and down motion twenty-five times using steel rod

(NOTE: Alsway distribute rodding strokes evenly by starting at outer edge and moving in a spiral toward center.)

G. Fill 2/3 of cone mold with concrete (Figure 3).

FIGURE 3

H. Rod twenty-five times, barely penetrating into first layer

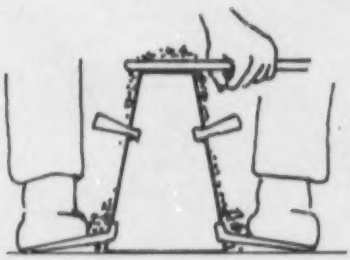
I. Fill cone mold to overflowing with concrete (Figure 4)

FIGURE 4

J. Again rod twenty-five times, taking same precautions about depth and distribution of strokes.

K. Level top of cone with steel rod so that cone mold is level full (Figure 5)

FIGURE 5



L. Clean excess concrete away from base of cone mold.

M. Immediately raise cone mold, taking only five to ten seconds to perform this operation.

(CAUTION: Perform this operation with a steady upward lift. Do not shake mold in any way or disturb the sample.)

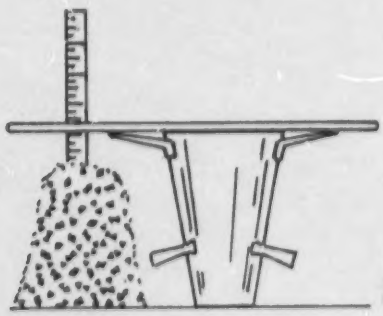
N. Place some mold next to sample upside down, taking caution not to disturb it

O. Place steel rod horizontally across mold so that it extends over the sample (Figure 6)

FIGURE 6

P. Measure distance from bottom of steel rod to the point of the original center of sample (Figure 7).

FIGURE 7



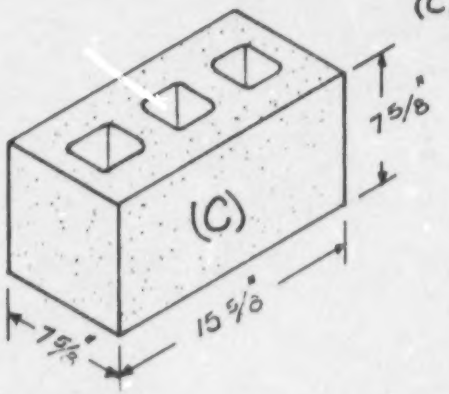
Q. This measurement, to the nearest 1/4", is the slump of the concrete.

CONCRETE BLOCK MASONRY

TYPES AND USES

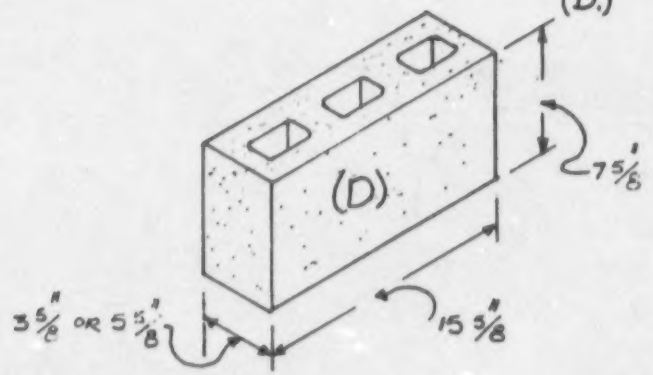
SHEET 2/5

(C.) DOUBLE CORNER OR PIER



USE: IT IS USED IN LAYING PIERS OR PILASTERS OR ANY PARTITIONS WHERE BOTH ENDS OF THE BLOCK WOULD BE VISIBLE.

(D.) 4" OR 6" PARTITION

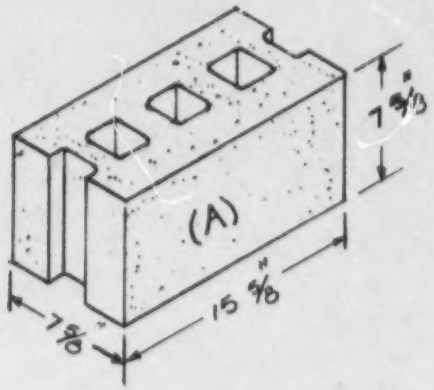


USE: IT IS USED IN CONSTRUCTING NON-LOAD BEARING PARTITION WALL.

CONCRETE BLOCK MASONRY

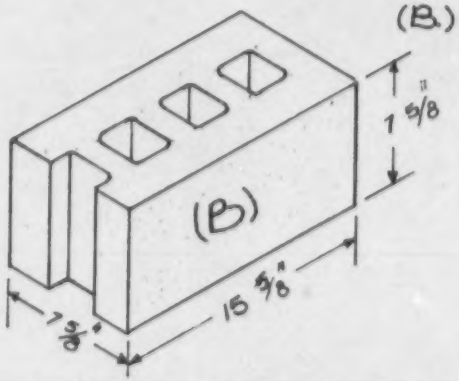
TYPES AND USES

SHEET 1/5



(A.) 8"x 8"x16" STRETCHER

USE: IT IS USED FOR THE EXTERIOR SURFACES.



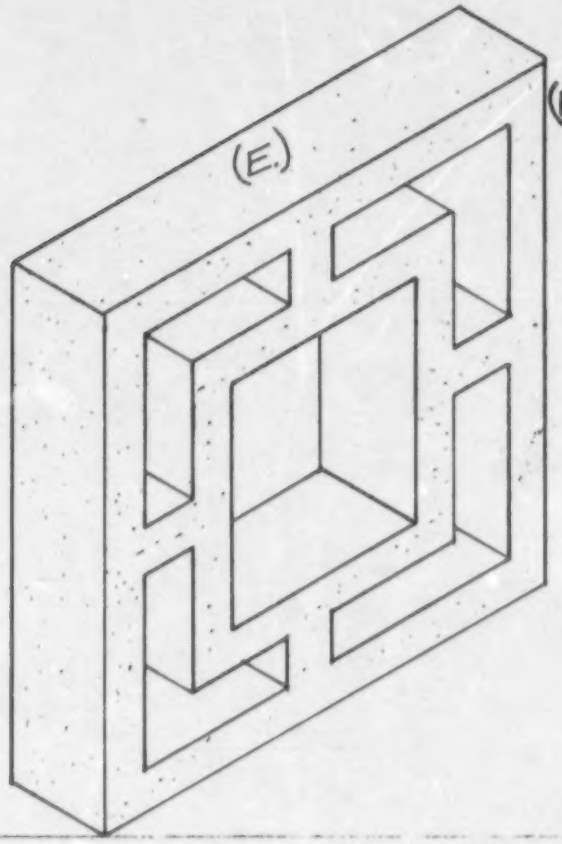
(B.) 8"x8"x16" CORNER

USE: IT IS USED FOR CORNERS AND FOR SIMPLE WINDOWS AND DOOR OPENING.

CONCRETE BLOCK MASONRY

SHEET 3/3

TYPES AND USES:



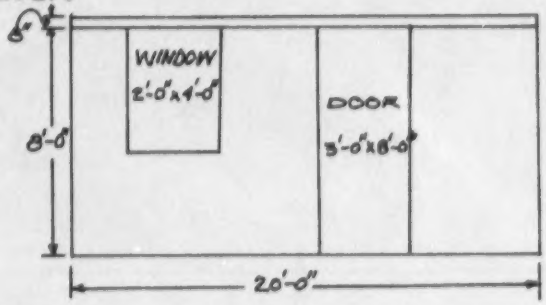
(E.) DECORATIVE BLOCK

USE: IT IS USED TO DECORATE STRUCTURES, AND SOMETIMES IT ALSO SERVES AS A BAFFLE.

CONCRETE BLOCK CALCULATION

8"x8"x16" CONCKETE HOLLOW BLOCK

NO. OF BLOCK	LENGTH	HEIGHT
1	1'-4"	8"
2	2'-8"	1'-4"
3	4'-0"	2'-0"
4	5'-4"	2'-8"
5	6'-8"	3'-4"
6	8'-0"	4'-0"
7	9'-4"	4'-8"
8	10'-8"	5'-4"
9	12'-0"	6'-0"
10	13'-4"	6'-8"
11	14'-8"	7'-4"
12	15'-0"	8'-0"



NOTE:
ALWAYS USE COMMON UNIT. CHANGE EVERYTHING TO ONE UNIT, EITHER FEET OR INCHES.

STEPS:
1. CALCULATE TOTAL WALL AREA.
2. SUBTRACT WINDOW & DOOR AREA FROM TOTAL WALL AREA.
3. DIVIDE TOTAL NET WALL AREA BY THE AREA OF ONE BLOCK.

FORMULA:

NO. OF PCS. 8"x 8"x16" BLOCK
= (20'-0"x8'-0") / (2'-0"x4'-0" + 3'-0"x8'-0")
= (160 SQ.FT.) - (32 SQ.FT.)
= 128 SQ.FT
= 128 ÷ .88
= 145.45

10% ADDED:
145.45 + 10%
= 145.45 + 14.54
= 159.99
SAY 160 PCS.

INTRODUCTION TO FORMING
UNIT VII

INFORMATION SHEET

1. Terms and Definitions

   A. Brace - A piece of wood or other material that directs, resists, or supports weight or pressure.

   B. Cleat - A strip of wood or metal fastened across a form for temporary positioning or to replace a form tie.

   C. Duplex nail - A double headed nail used in forming and designed for easy removal

   D. Footing - An enlarged area at the base of a wall or another object used to distribute the weight of the superstructure.

   E. Form tie- A wire or metal crosstie used to hold the pressure of wet concrete and maintain the proper wall thickness.

   F. Foundation - That portion of a wall upon which the building rests.

   G. Grade Point - The level of the finished concrete in a form.

   H. Key - A beveled strip of wood or metal placed on the form where future pours occur.

   I. Key Way - A groove left in the concrete by removal of the key.

   J. Monolithic Pour - A continuous mass of concrete cast as a single piece

   K. Scab - A piece of material nailed across a splice to strengthen and hold it together.

   L. Sheathing - Wide boards, plywood, or metal that make up the face of the form.

   M. Spreader - A block of wood that is used to hold the sides of the form apart and is removed as the concrete is poured; it may also be an integral part of the form tie.

   N. Spacer Block - A block of wood or other material used as a spacer at offsets in a form.

INFORMATION SHEET

O. Stake - Small boards or steel bars sharpened on one end and driven into the ground to support a form.

P. Dowel - A short piece of steel bar inserted through a bulkhead to tie the adjoining pours together.

Q. Bulkhead - A board placed in a form to cut off the concrete pour

R. Hopper - A receptacle, usually funnel shaped, open or with a gate at the bottom.

S. Vibrator - A power tool used to consolidate concrete.

T. Power Buggy - A machine used to transport concrete from the mixer to the pour site.

U. Form Oil - Paraffin oil or other manufactured product used on a form to prevent adhesion of concrete to the form.

V. Water Stop - A rubber, neoprene or some composition material used to prevent passage of water through a joint.

W. Reinforcing Bars - Steel bars used to strengthen concrete walls or beams; called rebars.

(NOTE: Rebar numbers are based on the number of 1/8 inches included in the nominal diameter of the bar. A#4 bar is 4/8 or 1/2 inch in diameter).

II. Purpose of a form - To hold the wet concrete to the desired shape until it has set.

III External factors that affect form design.

A. Slump - Reflects the consistency of the concrete as shown by a slump test.

(NOTE: At low air temperatures, the temperature of the concrete is also considered).

B. Rate of Pour-The vertical feet per hour of concrete placed within a form

C. Temperature - The air temperature at the time of pouring.

(NOTE: At low air temperatures, the temperature of the concrete is also considered).

D. Vibration - A method of consolidation of concrete within a form.

E. Method of placement - Discharge directly out of truck, crane with concrete bucket, power buggies, and pump.

INFORMATION SHEET

F. Size of form - Height, width, and length.

G. Type of concrete finishes

1. Architectural

2. Structural

IV. Effect of external factors on form design

A. Slump - The greater the slump, the longer it takes concrete to set, therefore, the pressure remains on the form for a longer period of time.

B. Rate of Pour - The feet of concrete depth poured in one hour.

C. Temperature - Effects the rate at which hydration (set) of concrete occurs; the higher the temperature, the faster concrete sets.

(NOTE: With a rate of pour of four feet per hour at 70°, the maximum pressure on the form is 550# per square feet. Using the same rate of pour at 50°, the maximum pressure increases to 750 p.s.f.).

D. Vibration - Power vibration can cause pressure to increase thirty-five percent.

(NOTE: Hand spading has very little effect on pressure).

E. Method of placement - Concrete weighs 150 pounds per cubic foot; the impact of this weight on concrete already placed causes an increase in pressure on the forms; the greater the height of the drop and the mass of concrete, the greater the pressure increase.

(NOTE: High free drops of concrete causes aggregate separation).

F. Size of form - Thickness and length of the wall are used to figure the rate of pour; height and width have no bearing on pressure on forms, except for method of placement.

(NOTE: For a given rate of fill, the pressure will be the same on a four inch wide wall as it is on a twelve inch wide wall.)

INFORMATION SHEET

G. Types of concrete finishes

1. Architectural concrete - Will be exposed in the finished areas of the structure; forms will be designed to give a minimum of deflection and leakage; the concrete surface may be smooth, rough, incised, sculptured, sandblasted, bushhammered, or many other finishes.

2. Structural Concrete - Will not be exposed in the finished areas of the structure, so some deflection and leakage is permissible.

V. Parts of a form (Transparencies 1, 2, and 3).

A. Sheathing

B. Brace

C. Stake

D. Spreader

E. Cleat

F. Form tie

G. Water

H. Stud

I. Strongback

J. Sole plate

K. Bottom Plate

L. Top Plate

M. Bulkhead

N. Scab

O. Key

P. Rustication Strip

Q. Chamfer Strip

INFORMATION SHEET

VI. Types of forms (Transparencies 4, 5, and 6)

A. Panelized - Wood

B. Built-In-Place Wood

C. Patented-All metal, all wood, a combination of wood and metal or fiberglass.

INTRODUCTION TO FORMING
UNIT VII

TEST

1. Match the terms on the right with the correct definition.

_____a.	A wire or metal crosstie used to hold the pressure of wet concrete and maintain the proper wall thickness.	1. Brace 2. Cleat 3. Duplex Nail 4. Footing 5. Form tie 6. Foundation 7. Grade point 8. Key 9. Key Way 10. Monolithic Power 11. Scab 12. Sheathing 13. Spreader 14. Spacer Block 15. Stake 16. Dowel 17. Bulkhead 18. Hopper 19. Vibrator 20. Power Buggy 21. Form Oil 22. Water Stop 23. Reinforcing Bars
_____b.	A beveled strip of wood or metal metal placed on the form where future thickness.	
_____c.	A block of wood or other material used as a spacer at offsets in a form.	
_____d.	Wide boards, plywood, or metal that make up the face of the form.	
_____e.	A short piece of steel bar inserted through a bulkhead to tie adjoining pours together.	
_____f.	A piece of material nailed across a splice to strengthen and hold it together.	
_____g.	A board placed in a form to cut off the concrete pour.	
_____h.	Small boards or steel bars sharpened on one end and driven into the ground to support a form	
_____i.	A block of wood that is used to hold the sides of the form apart and is removed as the concrete is poured, it may also be an integral part of the form tie.	
_____j.	A machine used to transport concrete from the mixer to the pour site.	

_____k. A power tool used to consolidate concrete

_____ i. The level of the finished concrete in a form.

_____ m. A receptacle, usually funnel shaped, open or with a gate at the bottom.

_____ n. A continuous mass of concrete cast as a single piece.

_____ o. That portion of a wall upon which the building rests.

_____ p. A groove left in the concrete by removal of the key.

_____q. Paraffin oil or other manufactured product used on a form to prevent adhesion of concrete to the form.

_____ r. A double headed nail used in forming and designed for easy removal

_____ s. A piece of wood or other material that directs, resists, or supports weight or pressure.

_____ t. A strip of wood or metal fastened across a form for temporary positioning or to replace a form tie

_____ u. An enlarged area at the base of a wall or another object used to distribute the weight of the superstructure.

_____ v. Steel bars used to strengthen concrete walls or beams; called rebars

_____ w. A rubber, neoprene or some composition material used to prevent passage of water through a joint.

2. Write the purpose of forms.

3. List seven external factors that affect form design.

   a.
   b.
   c.
   d.
   e.
   f.
   g.

      1.)

      2.)

4. Write the effects on form design caused by each external factor you have named in question number three.

   a.
   b.
   c.
   d.
   e.
   f.
   g.

5. Identify the seventeen parts of a form.

a.

b.

c.

d.

e.

f.

g.

h.

i.

j.

k.

l.

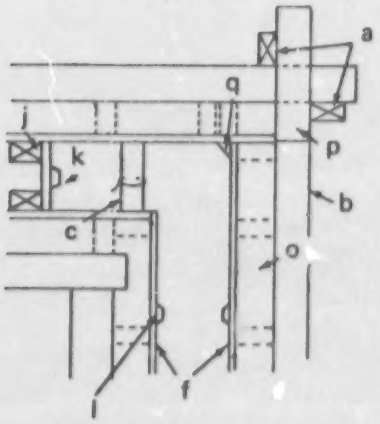
m.

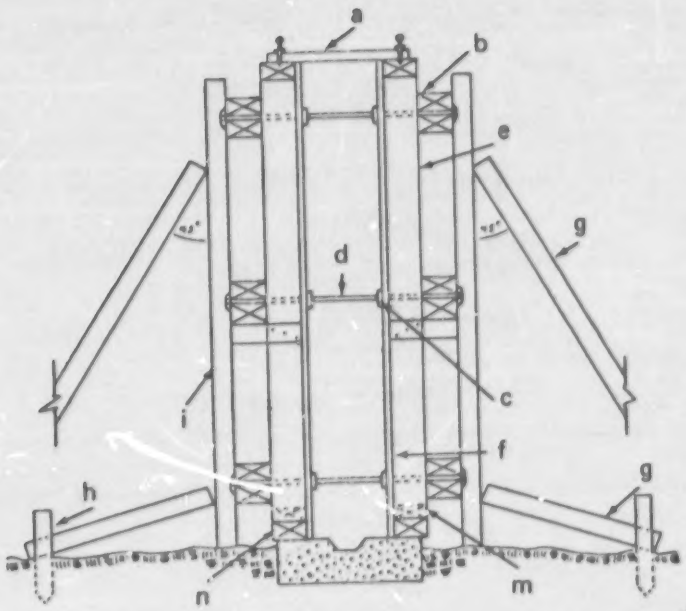
n.

o.

p.

q.





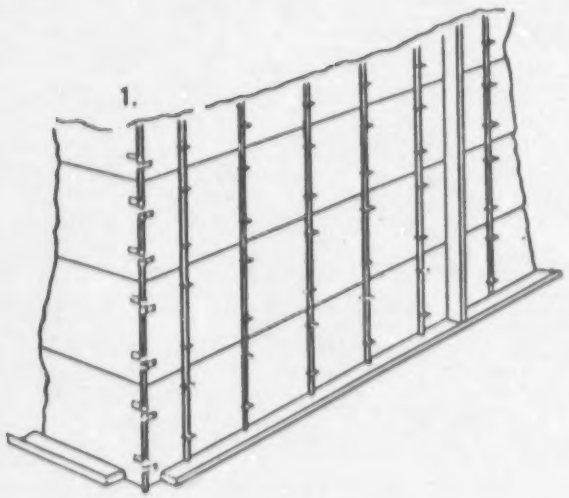
6. Identify three types of forms. Place the correct number(s) in the blanks given:

_____a. Panelized

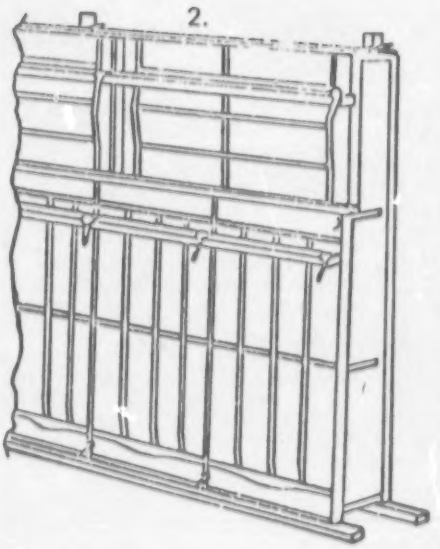
_____b. Built-in-place

_____c. Patented

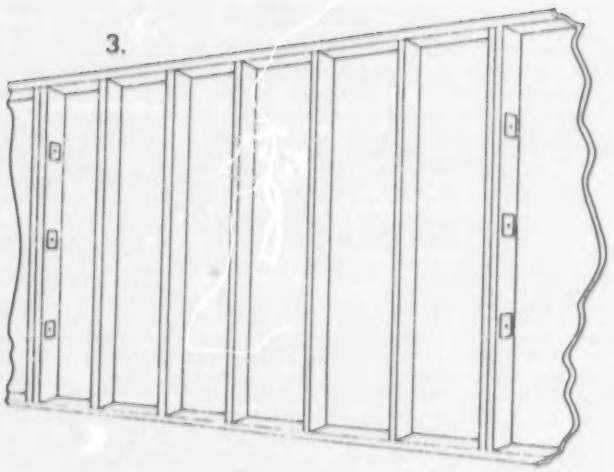
1.



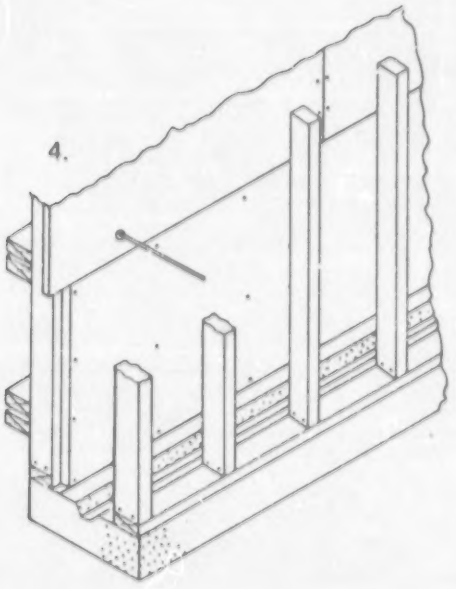
2.



3.



4.



APPENDIX G

INTRODUCTION TO FORMING

UNIT I

ANSWERS TO TEST

1. a. 5
   b. 8
   c. 14
   d. 12
   e. 16
   f. 11
   g. 17
   h. 15
   i. 13
   j. 20
   k. 19
   l. 7
   m. 18
   n. 10
   o. 6
   p. 9
   q. 21
   r. 3
   s. 1
   t. 2
   u. 4
   v. 23
   w. 22

2. To hold wet concrete to the desired shape until it has set

3. The following answers may be given in any order.

   a. Slump
   b. Temperature
   c. Rate of pour
   d. Vibration
   e. Method of placement
   f. Size of form
   g. Types of concrete finishes

      1. Architectural

      2. Structural

4. The following answers may be given in any order.

   a. Slump - The greater the slump, the longer it takes concrete to set, therefore, the pressure remains on the form for a longer period of time.

   b. Temperature - Affects the rate of which hydration (set) of concrete occurs, the higher the temperature, the faster concrete sets.

   c. Rate of pour - The feet of concrete depth poured in one hour.

   d. Vibration - Power vibration can cause pressure to increase thirty-five percent.

   e. Method of placement - Concrete weighs 150# per cu. ft., the impact of this weight on concrete already placed causes an increase in pressure on the forms; the greater the height of the drop and the mass of concrete, the greater the pressure increase.

   f. Size of form - Thickness and length of the wall are used to figure the rate of pour; height and width have no bearing on pressure or forms, except for method of placement.

   g. Types of Concrete finishes

      1.) Architectural concrete - will be exposed in the finished areas of the structure; forms will be designed to give a minimum of deflection and leakage; the concrete surface may be smooth, rough, incised, sculptured, sandblasted, bushhammered, or many other finishes.

2.) Structural concrete-Will not be exposed in the finished areas of the structure, so some deflection and leakage is permissible.

5. a. Cleats

b. Waler

c. Spreader

d. Form tie

e. Stud

f. Sheathing

g. Brace

h. Stake

i. Strongback

j. Bulkhead

k. Key

l. Rustication strip

m. Bottom plate

n. Sole plate

o. Top plate

p. Scab

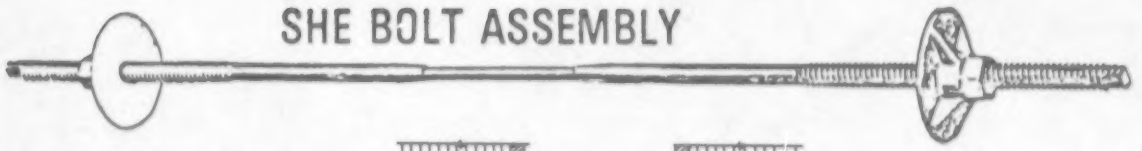
q. Chamfer strip

5. a. 3

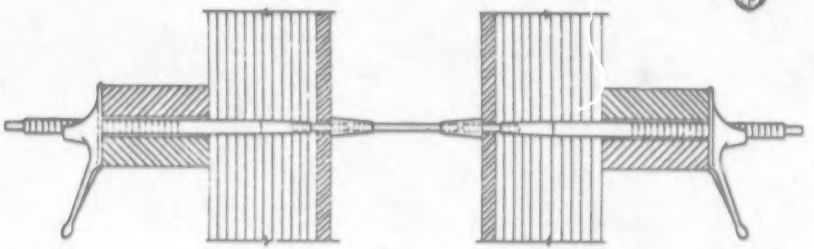
b. 4

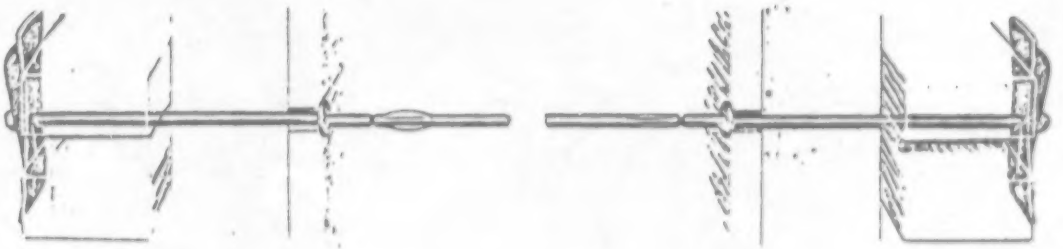
c. 1 or 2

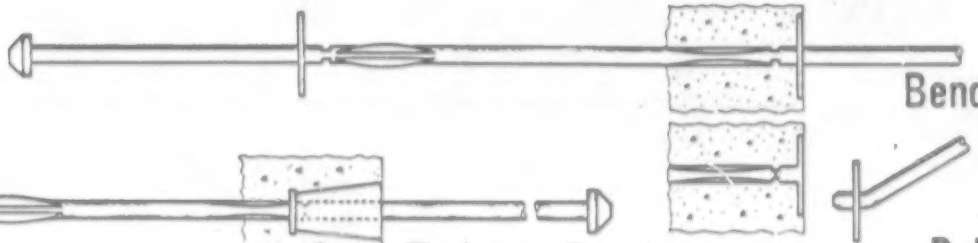
Form Ties

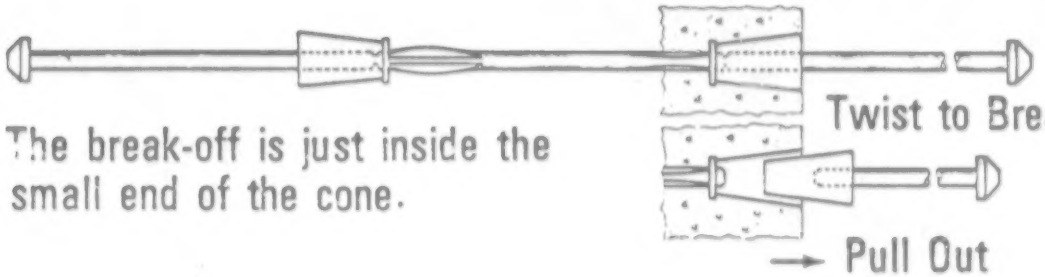


The Nut Washer Assembly consists of Two Outside Rods and Two Nut Washers









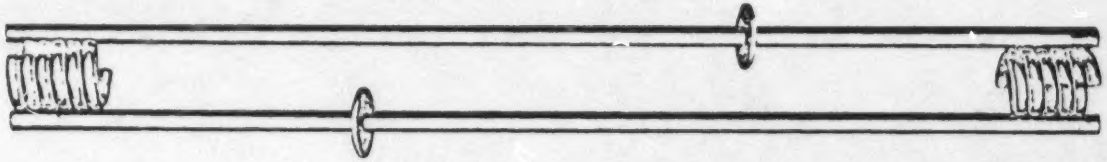
The break-off is just inside the small end of the cone.

59

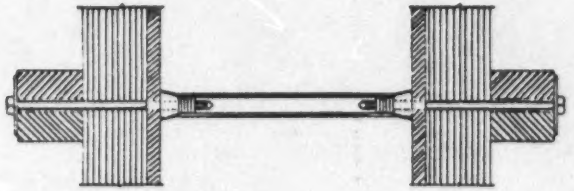
APPENDIX G
TRANSPARENCY 1

Form Ties
(CONTINUED)

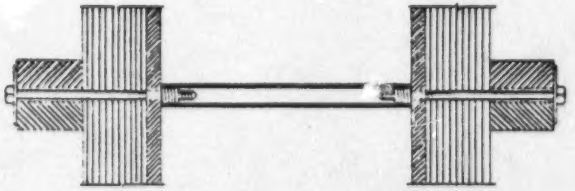
WATERSEAL COIL TIE



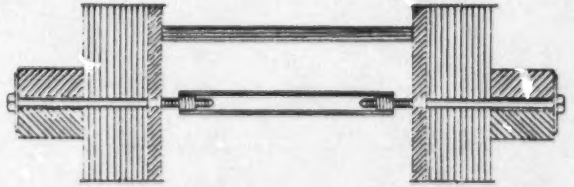
COIL TIE with SPREADER CONE



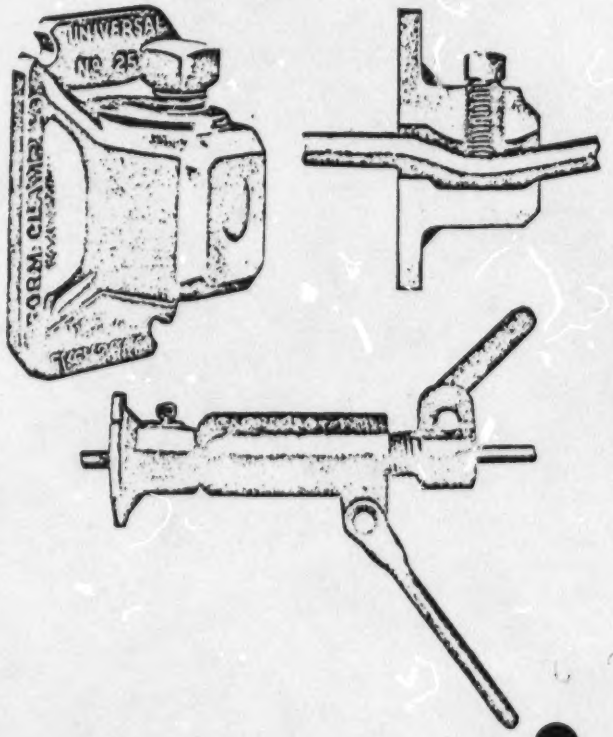
COIL TIE as SPREADER and TIE



COIL TIE with SEPARATE SPREADER

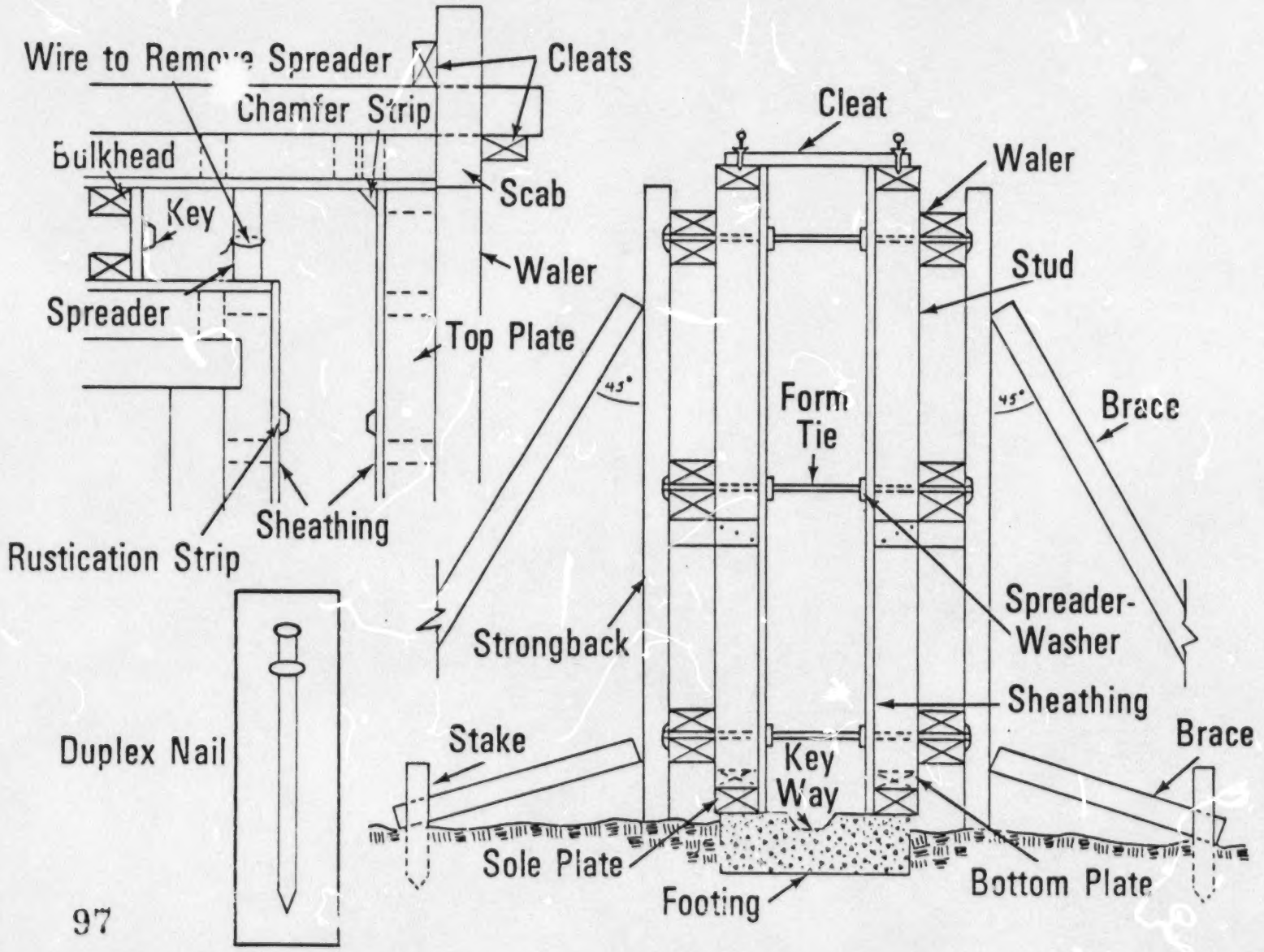


Form Clamps (Buttons) Used with Plain Round Mild Steel Rods



APPENDIX G
TRANSPARENCY 2

Parts of a Form



61

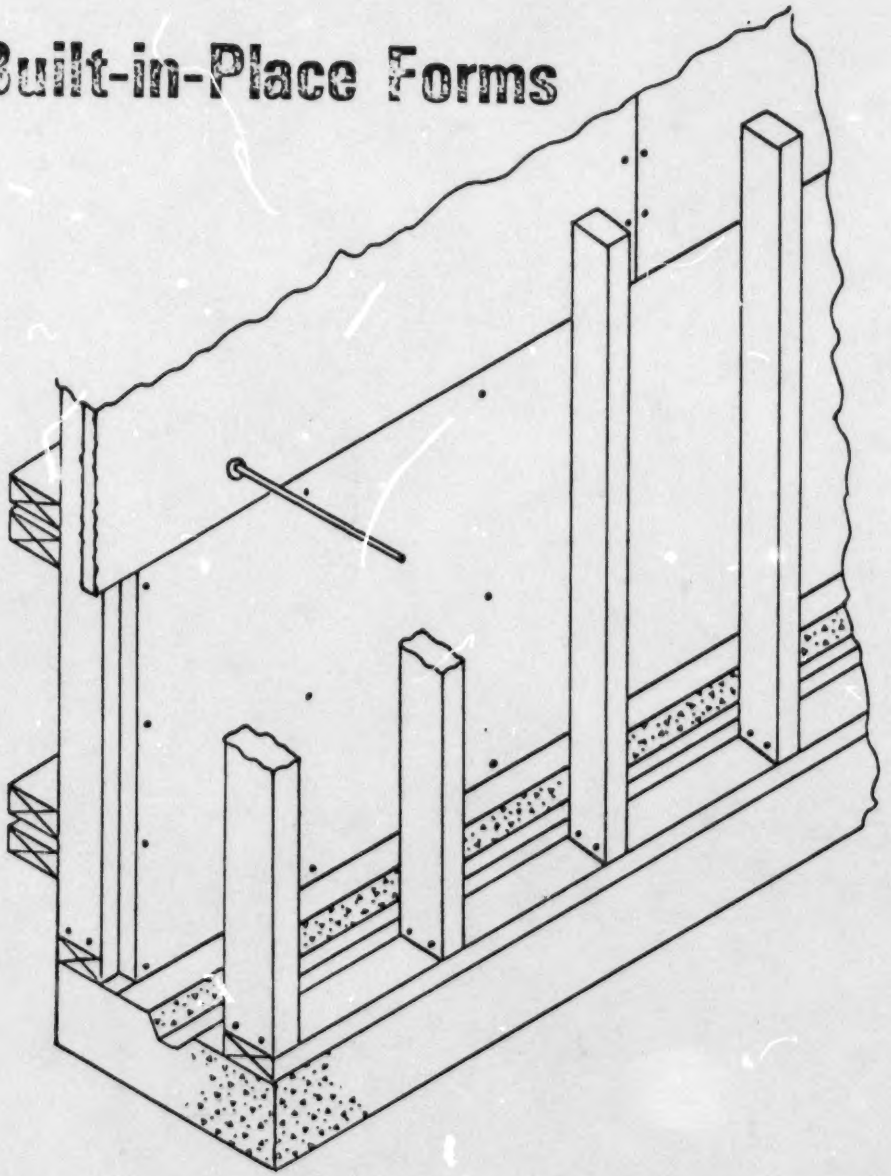
97

APPENDIX G
TRANSPARENCY 3

98

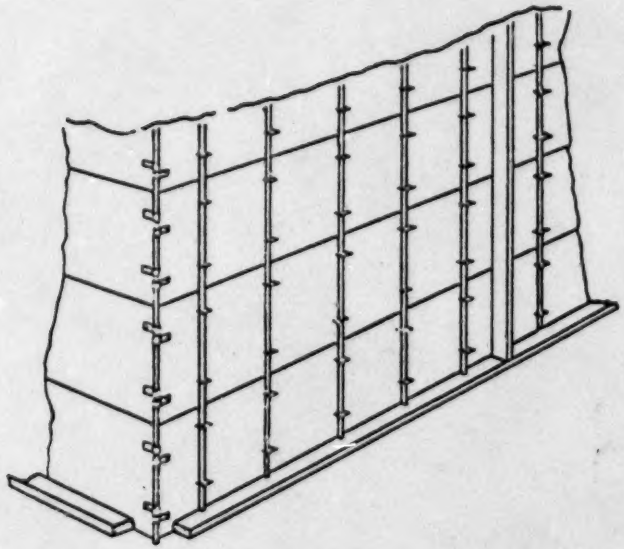
Panelized Forms

Built-in-Place Forms

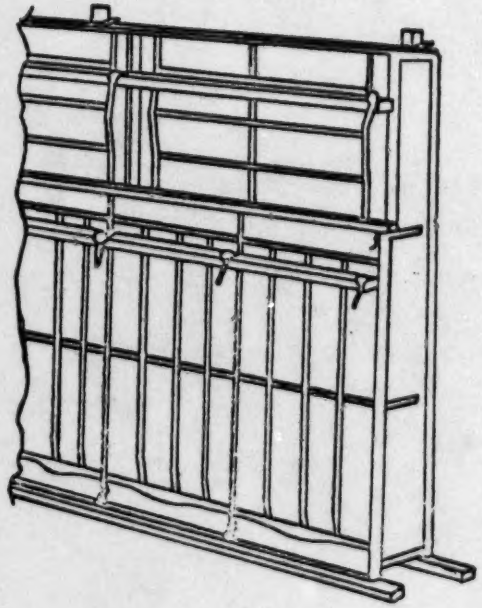


APPENDIX G
TRANSPARENCY 5

Patented Forms



Wood



Metal

64

APPENDIX G
TRANSPARENCY 6

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